An Assessment of Demand Response

Trends and Implications for the State of Michigan

Presentation to Michigan Public Service Commission Staff
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Lansing, MI

Researched by Jomo Thorne, 2007 ADDP Finance Consultant
Load Research Group, DTE Regulatory Affairs

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Presentation Outline

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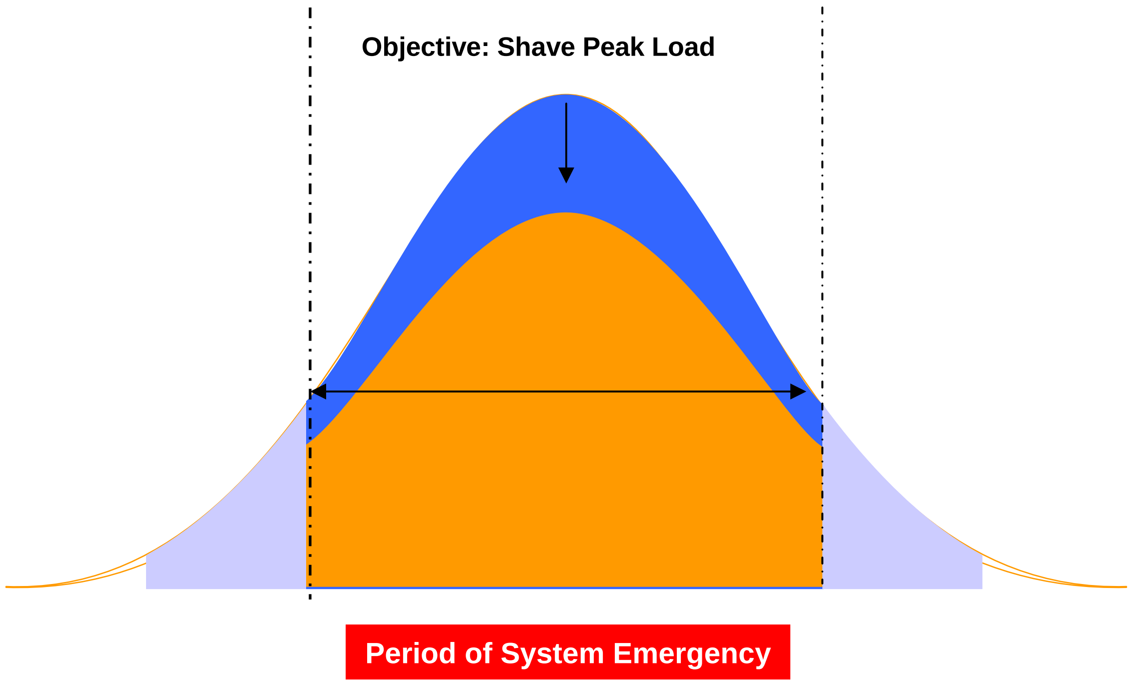
   - Demand Response Project Overview
   - Research Approach and Methodology

2. **Why Demand Response?**
   - Demand Response Drivers
   - Future of Michigan's Electricity Supply
   - Demand Response in Michigan
   - Detroit Edison's DR Portfolio

3. **DR Mechanisms and Enabling Technology**

4. **Emerging Issues**
   - Impact Measures
   - Enabling Technologies
   - Regulatory Barriers
   - Customer Responsiveness

5. Key Takeaways



Demand Response is increasingly important to utilities

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Demand Response may have important implications for…

Key Impacts

Financial Performance	**Operational and Capital Cost Savings** avoided generation, transmission and distribution costs
Customer Satisfaction	**Financial and Reliability Benefits to Customers** improved system reliability, cost savings on electric bills, and explicit financial payments for curtailment
Regulation	**Opportunity to Proactively Serve Public Interest** response to Federal and State regulatory action
Competitive Strategy	**Opportunity for Utility to Differentiate** reinforce perception of company working to lower costs while improving reliability

Demand Response Project Overview

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Purpose of Summer 2007 Research Project

1. **Examine national trends in Demand Response.**
2. **Determine possible implications for Detroit Edison and the state of Michigan.**
3. **Recommend demand response measures for Detroit Edison to undertake.**

Research Approach and Methodology

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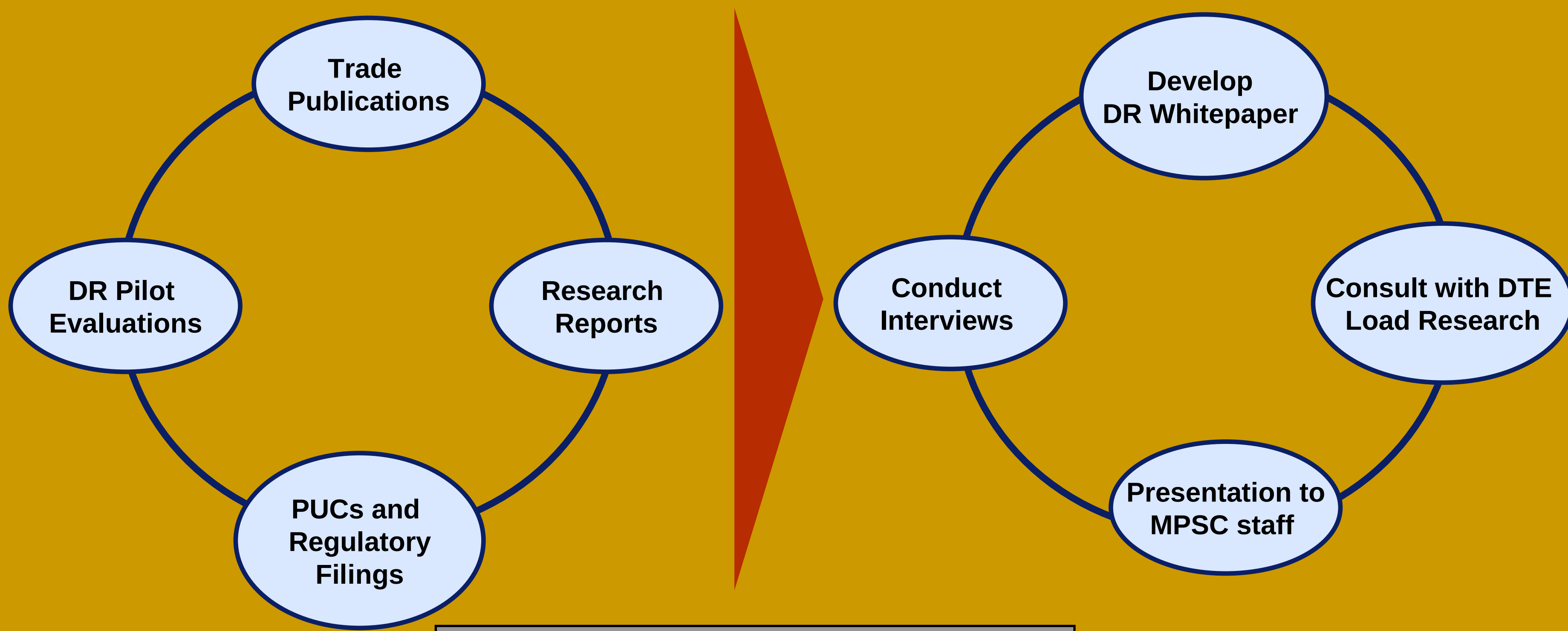
A. Conduct Background Research

B. Validate DR Pilot Suggestions



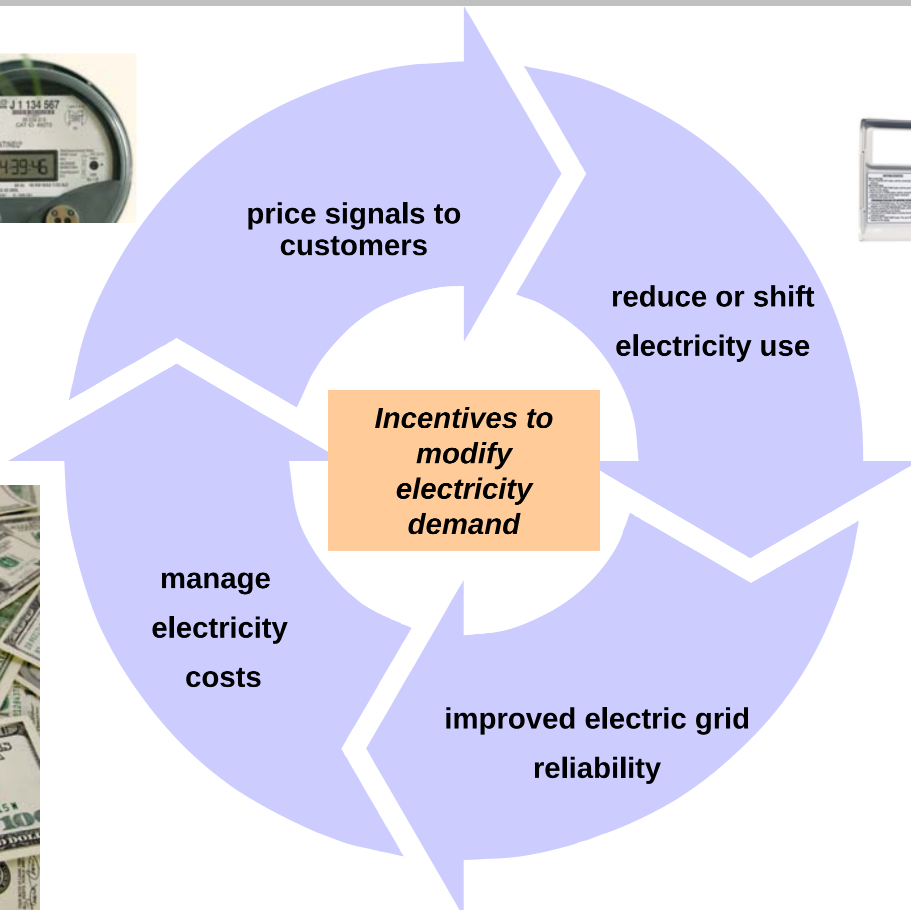
Identify DR Pilot Program Options and Systematize Data

Demand Response reduces/shifts load use during system emergencies

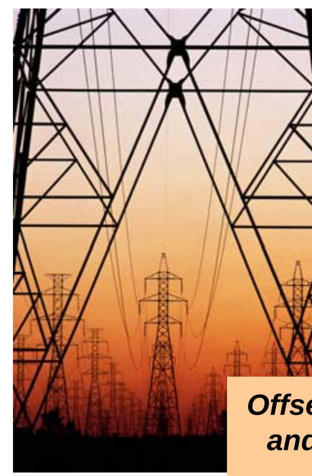
DR triggers chain reaction, reducing peak load, and decreases cost of supplying electricity

Deployed relatively fast

Customer savings on electricity bill



Avoided/deferred generation, transmission, distribution costs



Offset shortages and Improved system reliability

Interest in DR driven by market forces, policy innovation, and technology

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Lack of Capacity & High Demand

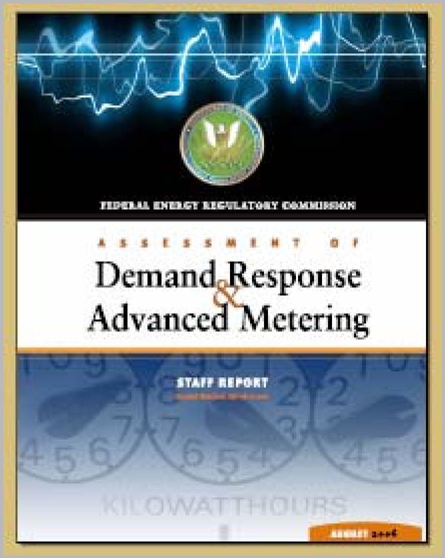
- 2006 US electricity output/sales second highest yearly total
- Relatively insufficient rate of investment in new generating capacity
- Aging grid and transmission infrastructure

Economics of Load Shedding

- Utility plant and capital cost requirements reduced with lower peak demand
- Avoiding large capital expenditures help keep rates lower

DR and Electricity Markets

- Use of electricity varies drastically during the day
- Lack of price-transparency leads to market inefficiencies
- DR reduces effects of variability thru pricing signal-inspired consumer rationing



EPAct 2005

- Mandated DOE/FERC reports on benefits of DR to Congress
- Reports highlight gap between *potential* and *actual* load shifting/reduction due to DR
- Prompts state action on DR

Advances in Metering Technology

- AMI provides an analytical tools for cost allocation and energy management
- Two-way communication, and other functionalities, facilitate DR automation

Ensuring Michigan's future electricity supply through Demand Response

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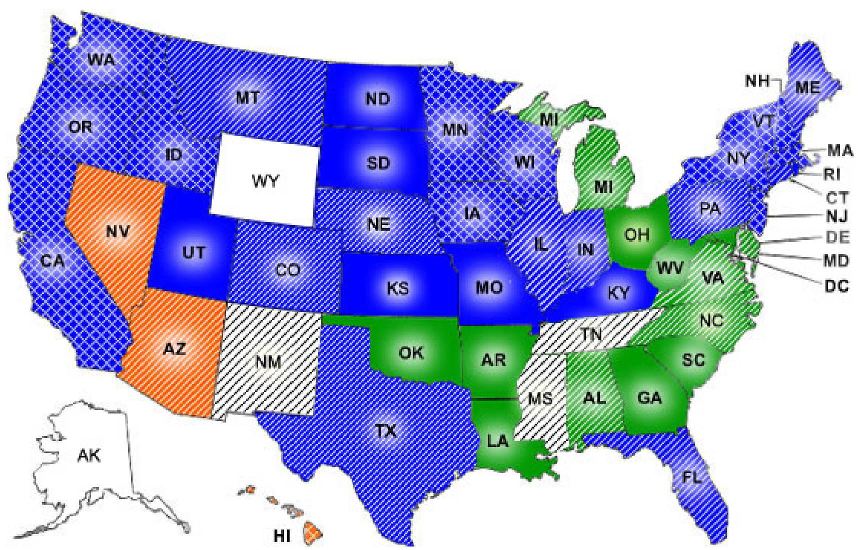
Summary of Nationwide Demand Response Activity



Source: DOE

- EE/DR programs
- Only DR programs
- Only EE programs
- Distributed Energy programs
- Gas EE programs
- No programs

- Michigan and Detroit Edison lag behind respective peers in number and type of demand response options.
- *Michigan 21st Century Electric Energy Plan* explores options to offset rising need for baseload generation.
- MPSC is encouraging utilities to develop portfolio of mitigation strategies (including EE, DR, renewable energy, and traditional baseload generation).
- Detroit Edison is proactively working to craft robust demand response strategy beneficial to the company and its customers.
- MPSC order creates statewide DR Collaborative (June 2007)

ACTIVE LOAD MANAGEMENT
(remote shut-down or cycling of electrical equipment)

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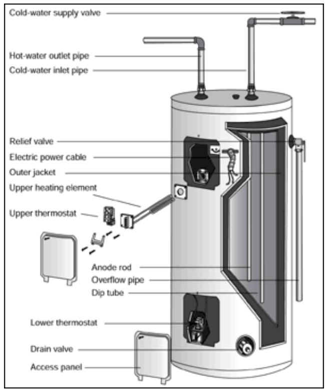
- Available on short notice to address system or local reliability contingencies
- Payment or bill credit provided as an incentive
- Direct Load Control (DLC) in operation since late 1960s, with rapid expansion in 1980s and 1990s
- Most DLC programs cycle operations of appliances (e.g. air conditioners and water heaters)
- One-way remote switch (digital control receiver) connected to appliance

- Remote switches have become more sophisticated with advent of new technology
  - Individually addressable switches allow for more targeted reductions to address localized problems
  - Remote control of individual appliances is being supplanted by remote control of smart thermostats
- Several key utilities phasing-out DLC
  - Concerns over age and state of equipment in older programs



PASSIVE CONTROL
(financial incentives to curtail electricity use)

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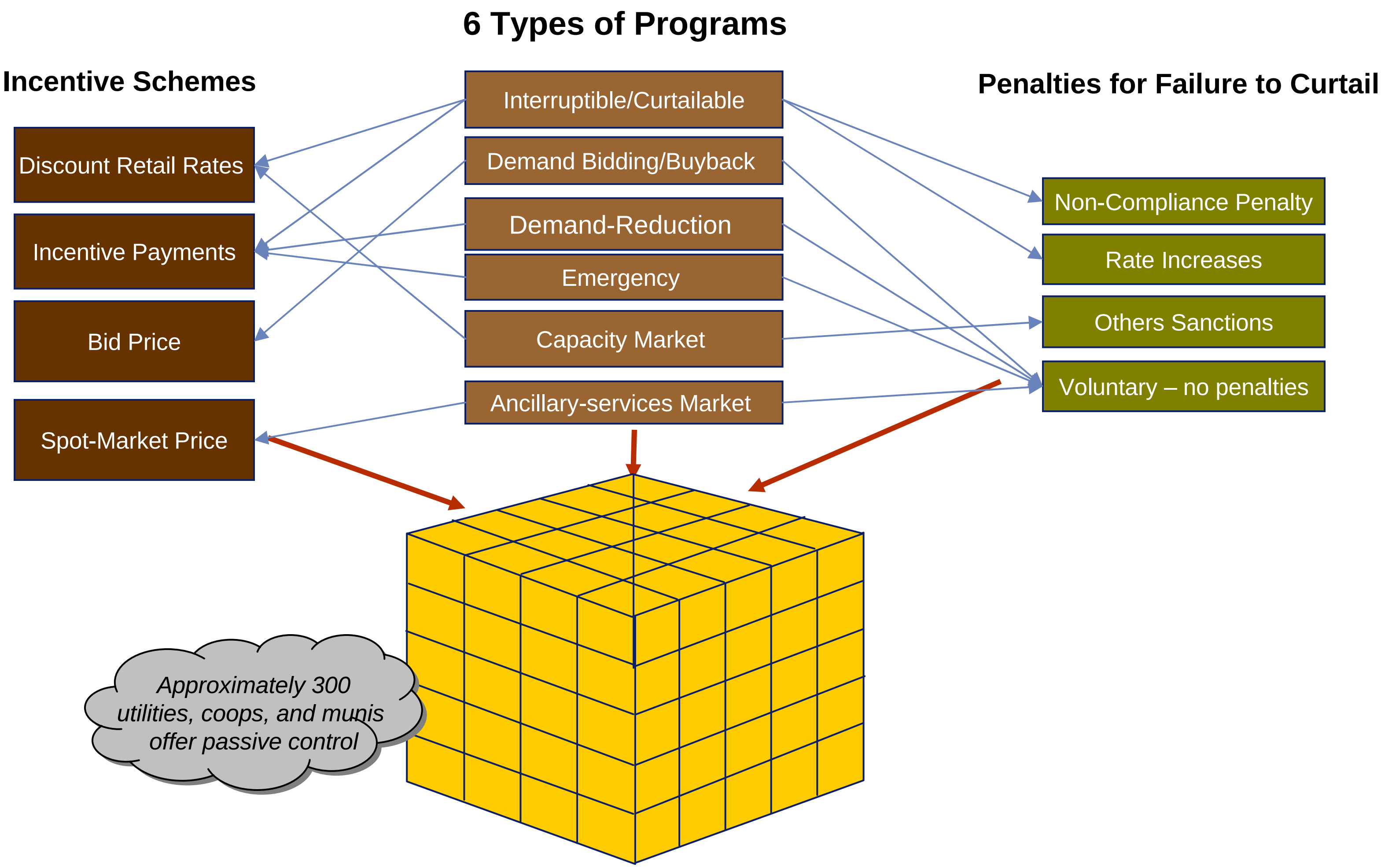
Current Passive Control Offerings



TIME-BASED RATES
(promote customer DR via direct price signals)

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Price Signal Impacts

Time-Based Rates	Load Reduction Method	Benefit/Drawbacks to LSE	Benefits to Consumers
TOU	• Rates vary by time period • Rates remain consistent • Rates known ahead of time to customer	• Some load management • Reliability of load reduction are concerns • Less effective without Interval Demand Recorder (IDR) enabled metering	• Reduction in energy costs
CPP	• Rates superimposed on top of TOU/flat rates • Real-time prices during extreme system peaking • Rates set much higher than TOU/flat • Variations: CCP-Variable, CCP-Fixed, CP-Rebates, and Critical Day Pricing (CDP)	• Effective means to expose customers to real prices during critical period • Shown to facilitate significant load reduction	• Lower energy charges on non-critical peak period days • Day-Ahead notification provides flexibility for operational planning • High customer satisfaction
RTP	• Rates reflect instantaneous change in wholesale price • Rates known on day-ahead or hour-ahead basis	• LSE recovers real costs of electricity generation and transmission	• Exposure to real prices leads to more efficient electricity consumption

Time of Use (TOU) — Critical Peak Pricing (CPP) — Real Time Pricing (RTP)

“Smart” Meter Evolution

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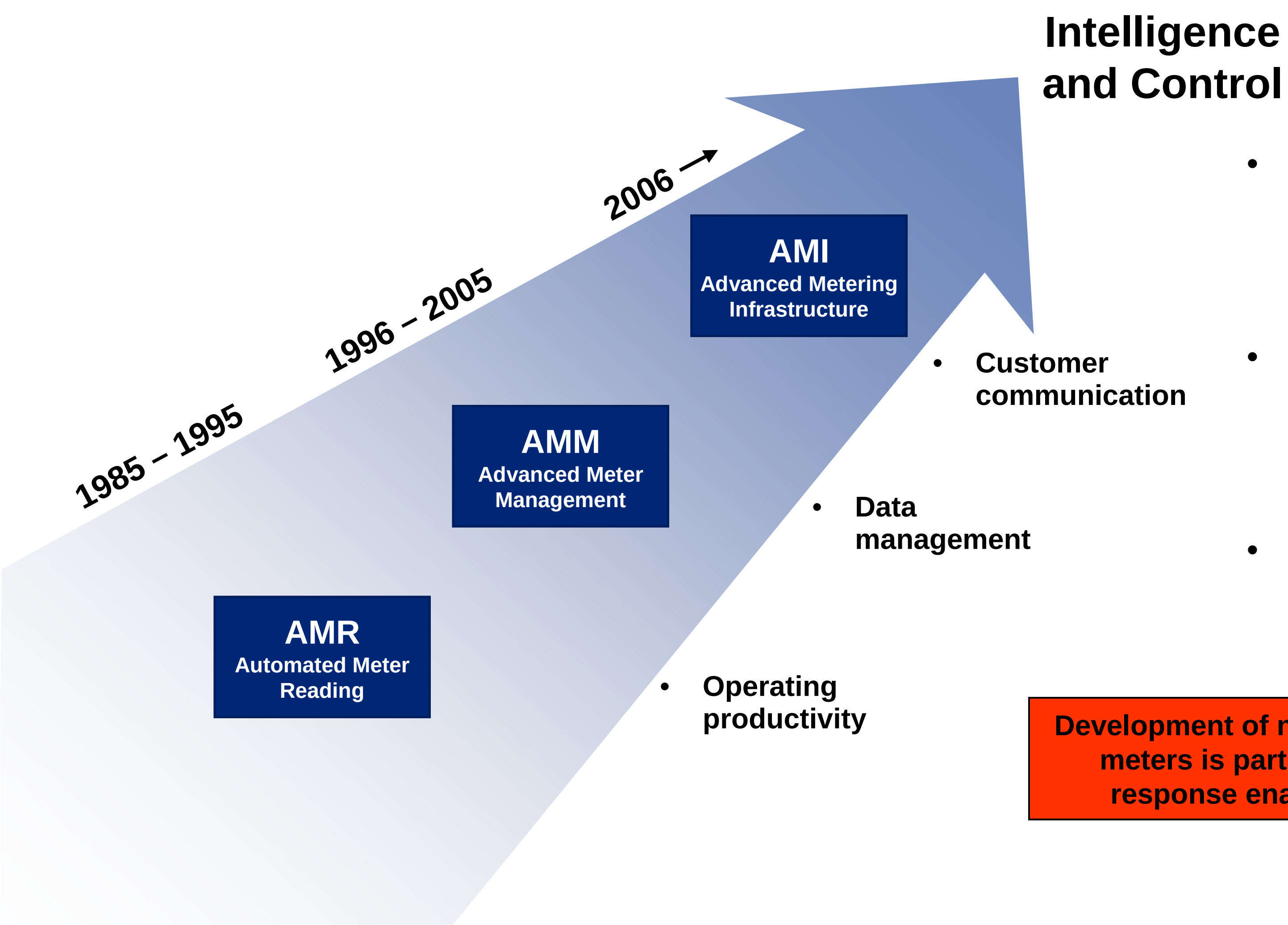

- **AMI developed to “enable” enhanced resource optimization**
- **AMM utilized to “enrich” information quality**
- **AMR implemented to “enhance” a critical process**

Development of next generation “smart” meters is part of surge in demand response enabling technologies

Source: Own analysis and Booz | Allen | Hamilton

Evolving Meter Functionality

System Feature or Element	Manual 	Automatic Meter Reading (AMR)	Advanced Meter Intelligence (AMI) 
Meters	Electromechanical	Hybrid	Hybrid or solid-state
Data Collection	Manual, monthly	Drive by, monthly	Remote via communications network, daily or more often
Data Recording	Total consumption	Total consumption	Time-based (usage each hour or more often)
Primary Application	Total consumption billing	Total consumption billing	Pricing, Customer options Utility operations Emergency DR KW, KVAR
Key Software Interface	Billing and Customer Information System	Billing and Customer Information System	Meter Data Management Billing and customer info Customer data display Outage management Emergency DR
Additional Devices Enabled	None	None	Smart thermostats In-home displays Appliance controllers

Sources: Individual analysis and *AMI: Overview of System Features and Capabilities* (eMeter Corporation)

Other Enabling Technologies

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- **Automation is key**
  - it may take more than variable tariffs and messages sent to a display to get "consumer response" in times of peak demand
  - in-home devices that act autonomously on the customer's behalf may be required
  - by incorporating information from a smart meter, smart appliances can react automatically to changing energy-rate information.

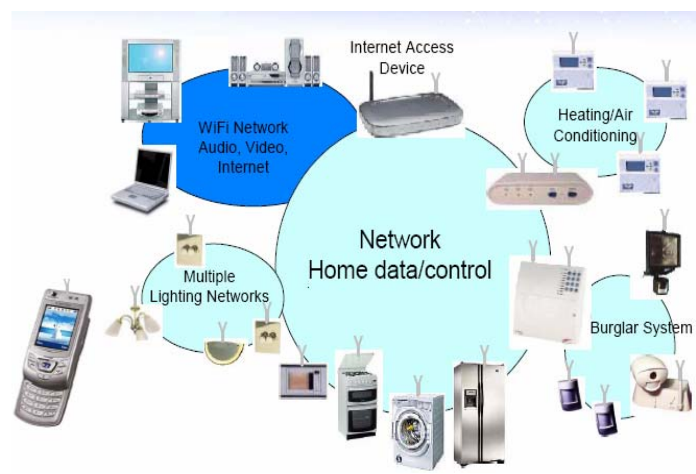
- **Smart meter networks are but the first steps in richer interaction between the utility and customers.**

- **Regulators in many countries looking "beyond the meter"… to facilitate DR**
  - devices in the consumer's home that provide real-time view of consumption and change their behavior
  - Complimentary technologies that open opportunities for innovation among large C&I customers

Smart thermostats

Home Networks

Smart Appliances



Emerging Issues in DR: Impact Measures

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Ultimate measure of DR's effectiveness is its ability to shift and/or reduce load demand, during peak periods, in a cost-effective manner

1. Cost Effectiveness

- Value streams (avoided supply costs of energy and demand, facilitated maintenance of the grid and generation resources, etc.) must be identified.
- These may be measured against the cost of supplying equivalent resources (e.g. cost of firing-up peakers)
- Four established cost-effectiveness tests.
- California Public Utilities Commission (Proceeding R.07-01-041) settlemen, and Demand Response Resource Center research/guidelines due in early 2008.

2. Customer Responsiveness

- How much is available and from what sources?
- DR Market Potential (DRMP) – sample test to determine amounts of DR that can be expected by offering options to customers (in particular market, under expected market conditions).

3. Measuring Actual Load Reductions (M&V)

- Determining universal standards for accurate and consistent measurements of load reduction is a key challenge.
- Until recently, lack of real-time customer-level load data also seen as barrier to establishing M&V methodologies.
- Detroit Edison's Load Research group in collaboration with the Demand Response Resource Center (DRRC) as part of an effort to set national M&V standards.

Emerging Issues in DR:
Other Regulatory Barriers

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FERC FEDERAL ENERGY REGULATORY COMMISSION

DLEG Public Service Commission
Labor & Economic Growth

<u>1. Disconnect Between Retail and Wholesale Prices</u>

- Resources allocation made more efficient by placing customers on time-based tariffs.
- Establishing time-based rates is an on-going process in most jurisdictions.

<u>2. Lack of Incentive for Utilities to Promote Demand Response</u>

- Most utility rates based on a combination of kWh and peak kW demand charges.
- Demand reductions associated with incentive-based DR negatively impacts utility revenues.
- Jurisdictions working on policy innovations that decouple profits from sales.

<u>3. Concerns Over Cost-Recovery for Investments in Enabling Technology</u>

- Utilities are reluctant to invest in enabling technology until uncertainty about rate recovery of advanced metering can be resolved. Recovery of at least part of utility investment in metering, through expensing or rate-basing, may be necessary.
- Cost recovery of advanced metering has been the subject of regulatory proceedings. Because deployments may require increase in rates, it is uncertain whether states will allow full deployments to be fully rate-based, amortized, or expensed.

Emerging Issues in DR: Customer Responsiveness

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1. Ease of Use

- Most customers (particularly residential) resist DR programs that require effort to understand and/or participate in.

2. Targeted Solutions

- Need for targeted, segment-specific DR options to address different needs and knowledge levels of *how* to respond, as well as their varying *abilities* to respond.

3. Enabling Technology

- Technology products that enable and automate demand response must be included in any DR program, and the costs of these are often subsidized by LSEs.

4. Multiple Communication Channels

- Dynamic-pricing program success rates increase when multiple notification channels (e.g. toll-free numbers, pagers, cell phones, and the Internet) are used.

5. Opt-In Programs Can Create a Self-Selection Bias Problem

- In some jurisdictions the levels of customer participation and aggregate load reductions are modest when participation in dynamic-pricing programs is voluntary.
- Opt-in programs can create a self-selection bias problem from the perspective of some LSEs.
- Customers tend to stay in voluntary programs with clear opt-out option.

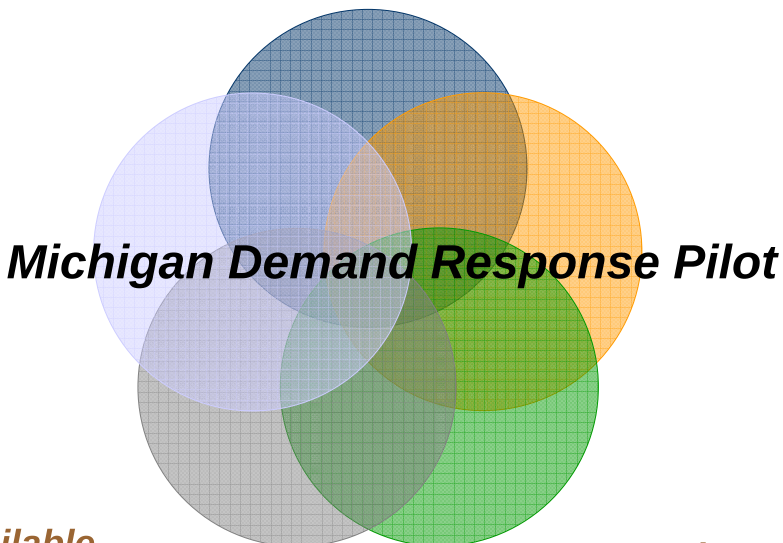
Key Takeaways: Suggestions for Michigan DR Pilot

Real Time Pricing (RTP)

- Sends most accurate price signals
- Have been shown to be effective in shedding residential load (Ameren)

Prepaid Energy

- Marginal contribution to load reduction
- May foster behavior shifting and customer-controlled savings



Critical Peak Pricing (CPP)

- Has demonstrated most dramatic load shifting results in pilot programs

(up to -27% peak electricity use reduction in CA SPP)

Interruptible/Curtailable

- Provide best form of control and predictability
- Impact of rates, when combined with AMI/enabling technology functionality, should be tested in Michigan

Time of Use (TOU)

- Enhanced/multi-tiered TOU offerings should be tested to gauge impact on Michigan consumers

Key Takeaways:
Strategic Considerations

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1. Strengthen Position as Low Cost/Reliable Competitor

- DR Deployment within Michigan's Policy and Competitive Environment
  - Increased retail competition, especially for large customers
  - Default service or historic franchise for small customers
  - Regional, regulated transmission and reliability services
  - Local, regulated distribution companies provide retail interface

- Utilities that compete in a hybrid market must rely on providing great *customer service*, a *reliable product*, at a *low cost*.

- A well-marketed and well-executed demand response program, with comprehensive customer education, can reinforce the perception of a utility is working to lower costs
  - ***Helping customers save money today, and avoid/reduce future rate increases, while improving reliability.***

Key Takeaways: Strategic Considerations (contd.)

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2. Improve Customer Satisfaction By Facilitating the Automation of DR

- Being strategic about automation and the DR-related customer service options can have impact on customer satisfaction.
  - Many utilities take a mass market approach to customer education and program promotion.
  - Customers often receive price signals at times when they are not receptive.
  - Program promotion yields are therefore expensive for the results gained.
  - ***Utilities that help customers connect demand response to their own bills and provide linkages/automation to suggested actions, may gain a competitive advantage through increased customer satisfaction.***

3. DR and Branding Opportunities

- Shifts to demand response tariffs may imply a host of changes to the customer-supplier relationship.
  - Because they are seen as premium or upgrade products, programmable thermostats and other enabling devices are attractive to both owners and occupants.
  - ***Installation of AMI/enabling technologies for DR may give a utility opportunity to make their brand visible right inside a customer's home.***
  - For example, branded enabling hardware may strengthen customer association of utility and responsible energy stewardship and innovation.

Key Takeaways: Issues to be addressed

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State legislators, regulators, and utility executives have many important choices to make to create robust DR programs in Michigan.

- Regulatory Barriers
  - Disconnect between retail and wholesale prices
  - Revenue disincentives imbedded in current rate structures
  - Fair AMI/enabling technology cost recovery methodology

- Demand Response Effectiveness Measures
  - Development of widely accepted and consistent M&V methodologies and cost-effectiveness tests
  - Developing tools that accurately measure customer uptake rates

- Address Barriers to Leveraging of AMI
  - Many utilities are waiting for industry standards before selecting AMI technology solutions
  - Uncertainty about technology, costs, and benefits of AMI
  - Vendors need feedback over product development

APPENDIX A: Rising U.S. Demand for Electricity

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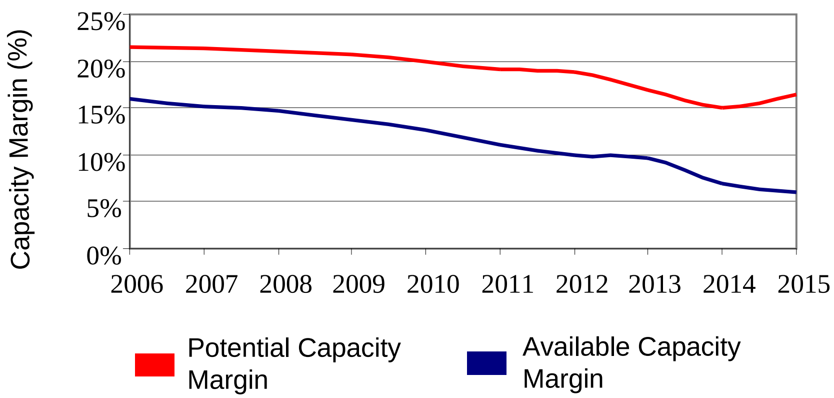
- Capacity margins in United States will continue to decline for foreseeable future
- Nation's electric output at all time high
  - output reaches highest yearly total ever recorded in 2005 and 2006
  - all-time weekly electric output record in July 2006
- Demand for electricity forecast to increase by at least 40% between now and year 2030
  - consumer demand projected to grow at average rate of 1.5% per year
- Electric power industry has increased capital expenditures to keep pace with growing demand.
  - Capex totaled $46.5 billion in 2005
  - Increased to nearly $60 billion in 2006
- Michigan is among largest producers of electricity
  - Ranked #10 in total net summer capacity (30,422 MW in 2005)
  - Ranked #12 in net generation (121,619,771 MWh in 2005)



Source: NERC

APPENDIX B: Advanced Metering Market

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- Next generation “smart” meters are part of surge in demand response enabling technologies
- Other technologies include enterprise energy management systems, energy management and control systems, wireless mesh networks, and on-site generation technologies
- Overall utility operational costs have dropped dramatically with the implementation of basic and advanced metering systems.
- Smart metering systems expected to save up to 50% in meter reading costs (in O&M, etc.) over the next five years

Rank	Driver	Time Horizon		
		1-2 Years	3-4 Years	5-7 Years
1	Energy Policy Act of 2005	High	High	High
2	Changing Mindset of Utilities	Medium	Medium	Medium
3	Reduced Operational Costs of Next Generation AMR	Medium	Medium	Medium
4	Improved Accuracy of AMR System	Medium	Medium	Low
5	Improved Load Forecasting Using AMR Data	Medium	Medium	Low
6	Better Outage Management	Medium	Medium	Low
7	Better Utilization of Human Resources	Medium	Medium	Low
8	Successful Implementation In Diverse Conditions	Medium	Medium	Low
9	Retaining Large-Customers Has Become Top-Priority	Medium	Low	Low

APPENDIX C: Benefits and Uses of AMI

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Benefits	Details
Increased accuracy of, and accessibility to meter reads	AMI eliminates manual meter reading and all related accuracy and access issues including (a) inaccurate and estimated bills, (b) property access difficulties, (c) electromechanical meter accuracy issues if SS meter deployed with AMI
Improved quality and reliability of energy delivery	AMI provides remote monitoring of the distribution network and enables (a) improved load forecasting, (b) faster and more reliable outage detection and restoration, (c) more efficient and informed planning of distribution assets, and (d) enhanced transformer load management
Timely, accurate, and effective customer care	AMI improves relationships with the customer and PSC in that it (a) addresses customers' questions and requests promptly and accurately, (b) improves customer service, and (c) reduces customer complaints
Collection and theft process efficiency	AMI enhances the collection and theft processes thru (a) the elimination of final estimated reads, (b) enhanced meter tampering detection, and (c) remote disconnect/reconnect capabilities
Accurate demand and consumption tracking	AMI enables customers to track their consumption and demand over the web and assist them with (a) adjusting their consumption according to their budgets, and (b) choosing a more convenient billing cycle to meet their income
Communication with complimentary devices/appliances	AMI further facilitates demand response by coordinating load management with smart thermostat, onsite generators, energy management systems and other devices

APPENDIX D: Emerging Issues With Enabling Technologies

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AMI Challenges

2007 survey confirms utilities are waiting for industry standards before selecting AMI technology solutions

1. **Lack of Industry Consensus on Direction**
2. **Lack of Standards or Proven Approach (meters, interoperability, enabling technology)**
3. **Uncertain Technology, Costs, and Benefits**
4. **Capex Dollars are Stretched in Addressing Basic Maintenance**
5. **Uncertainty Over Customer Education and Uptake Rates**

Sources: Own analysis, KEMA Inc., and Booz | Allen | Hamilton

APPENDIX E: Trends and Recent Performance of DR

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1. Reliability-Based Demand Response Programs are Performing Well

- Reliability-based DR has matured in the last five years
- Increasingly recognized as a viable resource

2. "Handholding" is Essential to High Responsiveness to Some Demand Response Programs

- Healthy response attributed to proactive customer engagement

3. Threat of Penalties Boosts Responsiveness

- Positive correlation between load curtailment and penalties for non-compliance

4. Economic Demand Response Demonstrates Mixed Results

- Wholesale market prices were not very high or spiky during summer 2006, hence economic DR programs were not called or did not garner much customer response
- Most utility execs interviewed had little information on the performance of dynamic pricing tariffs in 2006, and information on load impacts was not available
- A small number of economic demand response programs did generate considerable activity in 2006

5. Growing Focus on Resolving M&V Issues

- Many utility representatives do not yet regard economic demand programs (e.g., demand bidding) or dynamic pricing (e.g., RTP, CPP) as "firm" resources
- Ambivalence will continue until a standard for measuring and validating DR is established

6. Small-to-Medium Sized Commercial and Institutional Customers are Up-and-Coming Market

- Growth in role of third parties in aggregating load for demand response is expect continue
- Respondents to LBNL study identified small-to-medium sized commercial and institutional customers as a source of large untapped potential for demand response

7. Growing Interest in Fully Automated Demand Response

- LBNL researchers found that more widespread dissemination "fully automated" demand response can play an important role
- Auto-DR can improve the reliability and sustainability of DR while minimizing impact on customer comfort, convenience and productivity

APPENDIX F: DR Programs at Work
Gulf Power (CPP)

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Gulf Power's GoodCents SELECT

- Program elements:
  - TOU rate with a CPP component
  - smart meter that receives pricing signals and provides outage detection
  - customer-programmed automated response technologies
  - multiple ways to communicate rate changes and critical peak conditions to participants
- 7,200 Participants (2006)
- 96% Customer Satisfaction Rating
- $4.95 monthly charge

  (included smart thermostat, surge protector, and automatic outage notification)
- Technology gateway* programmed not to exceed 87 hours of Critical Pricing annually serves as hedge
- 1 hour notification prior to Critical Price implementation via indicator light on thermostat

- Customers save up to 15% on electricity bill annually
- Typical customers uses 3.8% less energy
- Significant Real-Time demand reduction
  - Summer: reductions range from 1.66 to 1.89 kW, with average of 1.73 kW per residence
  - Winter: reductions range from 1.86 to 2.44 kW, with average of 2.2 kW per residence

Rates Structure

Price Level	Price per kWh	% Annual Hours in Effect
LOW	6.8 cents	28%
MEDIUM	8.0 cents	59%
HIGH	12.6 cents	12%
CRITICAL	33.5 cents	1% max

APPENDIX G: DR Programs at Work
Georgia Power (RTP)

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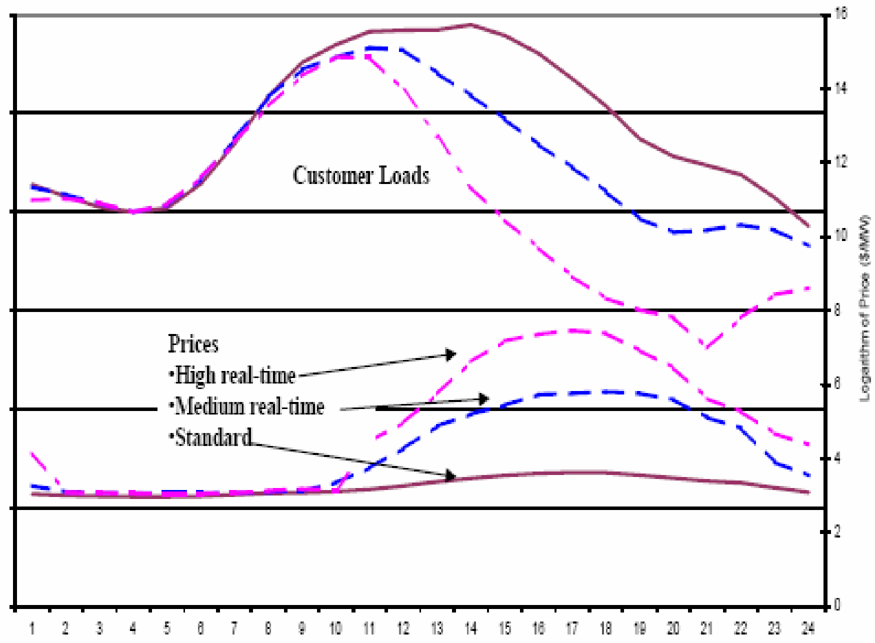
Georgia Power RTP

- 1,700 customers with peak demand [shedding] of nearly 5,000 MW
- Load drops in the 15-20% range
- 40-80% of the participants respond to the changing price levels
- Baseline usage based on historic demand, priced at embedded rates
- Two options: day ahead and hour ahead
- Interruptible for some customers, penalties for failure to interrupt
- Up to 1,000 MW of load reduction
- Total peak demand of 5,000 megawatts (MW)
- The program tariff has two parts:
  - Customer is billed for normal usage ("baseline") at standard prices.
  - Any usage at the margin, that is above or below the baseline, is billed at the real-time price.

- Predictable load response based on real-time prices charged (see chart)



Source: *RTP As A Demand Response Program, Christensen Associates, Peak Load Management Alliance Conference, Fall 2001.*

APPENDIX H: DR Programs at Work
Salt River Project (Prepaid Energy)

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Prepaid Electricity Meter

- Emerging use of smart meters in the sale of prepaid electricity
- Growing trend in which U.S. utilities
  - Utilities experimenting with pay-as-you-go services
  - Goal is to allow customers to monitor their own energy use and encourage conservation
  - A half-dozen utilities are trying prepaid programs now
  - Trend could accelerate quickly if Texas utility regulators approve rules this summer allowing it in their state
- Salt River Project, a Phoenix utility, has the largest prepaid program (M-POWER)
  - 55,000 of its 920,000 metered customers (some 5.98%) enrolled
- Demand side benefits and can help relieve accounts-receivable problems
- Experts expect prepaid electric service to become a standard feature of U.S. utilities, as it already is in the U.K., China and South Africa, within 5 years
- Prepaid energy program may be leveraged to promote demand response
  - Prepaid energy program may promote behavior shifting and customer controlled savings
  - When combined with an appropriate time of use tariff, a prepaid energy program could be leveraged to achieve demand response load shedding goals.